The U.S. Purchase of Highly Enriched Uranium (HEU) from Russia

LLNL's technical expertise undergirds "transparency" in implementing the agreement to convert weapons-grade uranium into fuel for electricity.

In 1993, the United States signed an agreement with the Russian Federation to purchase highly enriched uranium (HEU) that has been extracted from Russian nuclear weapons. Under this agreement, the HEU is blended down in Russia to low enriched uranium (LEU) and then shipped to the United States, where the LEU is used in making fuel for nuclear power reactors.

A 20-year purchase contract was signed in 1994 between the Russian organization Techsnabexport (the marketing arm of MINATOM) and the United States Enrichment Corporation (USEC). This contract allows USEC to purchase over 500 metric tons (1,100,000 pounds) of HEU, from dismantled Russian weapons, in LEU form.

"Transparency" Provides Assurance

The United States and Russia agreed to implement various "transparency measures" as a technical basis for assuring each government that the other is abiding by the agreement.

For the United States, transparency implementation is to provide confidence that the LEU being delivered is indeed derived from weapons HEU. The Russian Federation's transparency rights provide it with confidence that the LEU being delivered to the USEC is being used as fuel for nuclear power plants and not re-enriched to weapons-grade uranium.

Russian museum display of nuclear weapons possibly subject to the HEU purchase agreement.

These transparency measures involve on-site monitoring, document review, and the use of instrumentation designed to measure ^{235}U enrichment. Lawrence Livermore National Laboratory (LLNL) provides overall technical support to the U.S. Department of Energy for these transparency measures.

How the U.S. Implements Transparency in Russia

U.S. personnel monitor four uranium production and processing plants in Russia, where the weapons-grade HEU that has been enriched with the fissile ^{235}U isotope is converted into LEU. The conversion steps include:

- Delivering the HEU weapons components to the processing plant.
- Machining the components into metal shavings.
- Heating the metal shavings to oxidize them.
- Removing any contaminants from the HEU-oxide by chemical means.
- Converting the HEU-oxide into uranium-hexafluoride gas.
- Producing an LEU-hexafluoride gas by physically diluting the HEU-hexafluoride gas (blending it down) to a low level of enrichment.

The on-site monitoring by U.S. personnel involves a mix of permanent presence and short five-day visits to the sites where these conversion steps are taking place. The monitors use a variety of methods, including nondestructive assay equipment, tags, seals, and structured observations.

Data obtained from these visits are comprehensively analyzed in the United States to help confirm Russia's compliance and to guide future monitoring efforts.

How Russia Implements Transparency in the U.S.

At the Russian blending facilities, the LEU-hexafluoride gas is loaded into shipping cylinders and sent to USEC in the United States. The LEU is subsequently delivered to fuel fabricators, where it is manufactured into nuclear-reactor fuel-rod assemblies

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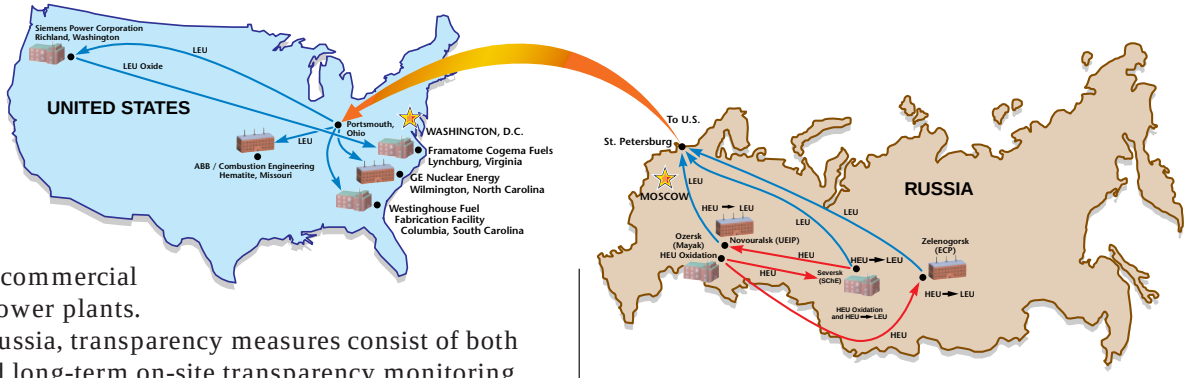
The red lines show the flow of HEU within Russia, where it is converted to LEU (blue lines) and shipped to the U.S. to be made into fuel for commercial nuclear power plants.



for use at commercial nuclear power plants.

For Russia, transparency measures consist of both short- and long-term on-site transparency monitoring and document reviews at USEC's blending plant at Portsmouth, Ohio, and at five U.S. fuel fabricators. This provides Russia with confidence that the LEU is being used only as nuclear-reactor fuel for peaceful purposes.

Partnerships in the Transparency Activities

In the United States, the Department of Energy (DOE) is responsible for developing and implementing the transparency requirements of the bilateral agreement. DOE works closely with its counterpart in Russia, the Ministry of Atomic Energy (MINATOM), to develop and implement transparency measures that are acceptable to both countries. DOE's Office of Nonproliferation and National Security is responsible for developing, participating in negotiations on, and implementing transparency measures. These activities are conducted in cooperation with the Department of State, the Nuclear Regulatory Commission, and USEC.

The U.S. program is implemented primarily by personnel from the DOE national laboratories, with LLNL providing overall technical support to the DOE Program Office.

LLNL: A Center of Transparency Expertise

Most of LLNL's staff for this transparency work are located at Livermore, California, where they can immediately take advantage of the Laboratory's vast technical resources and established infrastructure. Other staff members are in Germantown, Maryland, close to DOE's headquarters, where they can rapidly respond to changing DOE requirements.

In addition to its overall technical support, LLNL has specific responsibilities in:

- Scheduling and providing technical guidance to the monitoring activities.
- Playing a key role in monitoring activities.
- Leading the data analysis effort.
- Supporting the Russian transparency effort in the United States.
- Supporting the monitoring activities by:
  - — Training
  - — Development and maintenance of nondestructive assay equipment
  - — Health and safety management
- Providing technical support to the negotiation process.

Impact of the HEU Purchase Agreement

LLNL's technical expertise is a key element in the U.S. effort to reduce the amount of weapons-grade uranium in Russia by converting it to LEU for use as commercial-sector nuclear fuel. By the end of the 20-year contract, 500 metric tons of HEU from dismantled Russian nuclear weapons will have been downblended to LEU. According to the International Atomic Energy Agency's definition of a significant quantity (1987 IAEA safeguards glossary), this would be enough to make approximately 20,000 nuclear explosive devices. In this arrangement, the United States and Russian governments and the world's people are all winners.

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